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Bathing and showering: Under-appreciated sources of water pollution from medicines

SAN FRANCISCO, March 24, 2010 — That bracing morning shower and soothing bedtime soak in the tub are potentially important but until now unrecognized sources of the hormones, antibiotics, and other pharmaceuticals that pollute the environment, scientists reported here today at the 239th National Meeting of the American Chemical Society. The first-ever evaluation they said, could lead to new ways to control environmental pollution from active pharmaceutical ingredients (APIs), which has been the source of growing concern.

Ilene Ruhoy, M.D., Ph.D., who co-authored the study, said that scientists have long known that bathrooms are a portal for release of APIs into the environment. An active ingredient in a pill is the medicine, usually combined with binders to hold the pill together, stabilizers, and other inactive ingredients. However, scientists and pollution control officials assumed that toilets were the main culprit, with APIs excreted in urine and feces and flushed into sewers and sewage treatment plants. APIs may go right through the disinfection process at those plants, and enter lakes, rivers, and oceans. Some also end up in the environment when people flush unused drugs down the toilet. Scientists have found traces of the active ingredients of birth control pills, antidepressants, and scores of other drugs in waterways. Some end up in drinking water – at extremely low, trace levels.

“We’ve long assumed that the active ingredients from medications enter the environment primarily as a result of their excretion via urine and feces,” said Dr. Ruhoy. She directs the Institute for Environmental Medicine at Touro University in Henderson, Nev., and did the research with Christian Daughton, Ph.D., of the U.S. Environmental Protection Agency’s National Exposure Research Laboratory in Las Vegas. “However, for the first time, we have identified potential alternative routes for the entry into the environment by way of bathing, showering, and laundering. These routes may be important for certain APIs found in medications that are applied topically, which means to the skin. They include creams, lotions, ointments, gels, and skin patches.”

Ruhoy and Daughton identified this potential new source of APIs through a comprehensive review of hundreds of scientific studies on the metabolism and use of medications. They focused on APIs in medications that are applied to the skin or excreted from the body via sweat glands. These two sources can result in residues being washed off the body and down bathroom drains. These include steroids (such as cortisone and testosterone), acne medicine, antimicrobials, narcotics, and other substances.

Another previously unrecognized route by which APIs may reach the environment includes perspiration (many APIs are released in sweat) and laundering of clothing that has come into contact with topical medications from their dermal application or from sweating.

Ruhoy explained that some APIs in topical medications enter the environment in a form that has the potential for having greater impact than those released in feces and urine. While some medications are excreted substantially unchanged, and therefore enter the environment as the parent compound, other APIs, prior to

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Showering and bathing wash medicated creams and ointments off the skin, down the drain, and into the environment.

Credit: Wikimedia Commons;

photo by DO'Neil

([High-resolution version](#))

excretion from the body, are largely metabolized, or broken down, in the liver and kidneys.

“Topical APIs, from bathing and showering, however, are released unmetabolized and intact, in their full-strength form,” Ruhoy said. “Therefore, their potential as a source of pharmaceutical residues in the environment is increased.”

Ruhoy cited steps by which consumers can reduce the potential environmental impact of these skin-based pharmaceuticals by following directions and applying only the recommended amount, rather than thinking that “if a little is good, more must be better.” Doctors can help by prescribing the lowest possible dose for the shortest period of time necessary. Scientists should continue efforts to develop better drug delivery systems for topical medications so that APIs, for instance, are absorbed faster and more completely, she said. Design of dermal patches so that less API residue remains after use would be particularly helpful in reducing accidental poisonings from carelessly discarded patches and the quantities of APIs flushed down toilets.

“We need to be more aware of how our use of pharmaceuticals can have unwanted environmental effects,” Ruhoy said. “Identifying the major pathways in which APIs enter the environment is an important step toward the goal of minimizing their environmental impact.”

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